PATENT ABSTRACTS OF JAPAN

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E01D 7/02

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(22)Date of filing : 04.06.1992

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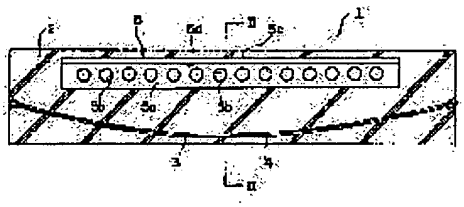
(72)Inventor : NODA YUKIE

(54) PRESTRESSED CONCRETE GIRDER AND ITS MANUFACTURE

(57)Abstract:
PURPOSE: To provide a prestressed concrete girder which can be simply executed, and dispenses with a large-scale device and a wide manufacturing yard, and is high in rigidity and low in the height of a girder.
CONSTITUTION: A sheath 4 having a tension steel member 3 inserted through the tensile edge of a precast concrete member 2 is buriedly provided in a PC girder 1, and a thick plate steel member 5 for resisting compressive force is buried in the compressed edge of the upper part of the girder. The thick plate steel member 5 has a T-shaped section, and plurality of concrete pouring through-holes 5b are bored on the web 5a of the thick plate steel member 5. Since the concrete during depositing sufficiently turns round to the lower face 5d of a flange 5c through the through holes 5b, adherence between the thick plate steel member 5 and the concrete can be improved. An extremely thick steel plate being resistible against compressive force is applied to the flange 5c of the thick plate steel member 5. An ordinary PC steel wire is used for the tension steel member 3.



LEGAL STATUS

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PATENT ABSTRACTS OF JAPAN

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TANAKA TOMOO
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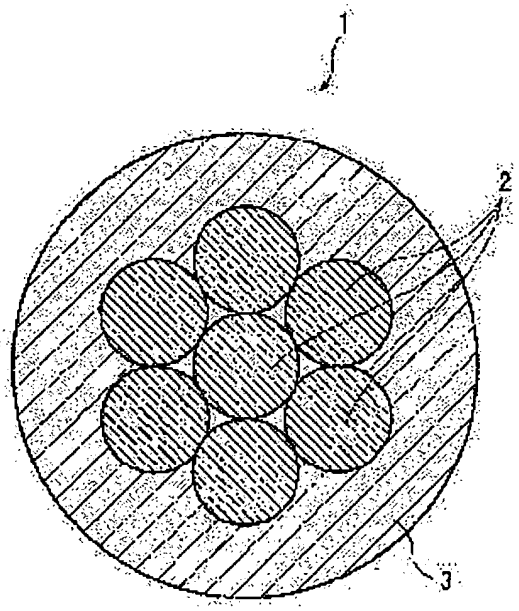
(54) ELECTRIC CABLE AND MANUFACTURING METHOD OF THE SAME

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an electric cable with high strength capable of recycling without using any reinforcing material, and a manufacturing method of the same.
SOLUTION: The manufacturing method of the electric cable comprises an electric cable extrusion process forming a temporary cable by conveying wires and a molten insulation body with respective speeds different from each other, pushing out the above from a cross head of an extruder in a not-stuck state, and cooling it; and an electric cable drawing process forming the electric cable by reducing a diameter of the temporary cable by drawing it while heating, and gradually cooling it. The electric cable is composed of wires and the insulation body covering the wires, and a tensile strength of the cable is 100 Mpa or higher.



LEGAL STATUS

[Date of request for examination]

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[Date of final disposal for application]

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decision of rejection]
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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1]
It is the electric wire characterized by being the resin ingredient with which said insulator was extended in the electric wire which consists of a conductor and an insulator which covers it, and the tensile strength of said electric wire being 100 or more Mpas.
[Claim 2]
The structure of said resin ingredient is an electric wire according to claim 1 characterized by carrying out orientation.
[Claim 3]
Said resin ingredient is an electric wire according to claim 1 characterized by crystallizing.
[Claim 4]
Said resin ingredient is an electric wire given in claim 1 characterized by being a polyolefine system resin ingredient, being a polyamide system resin ingredient, or being a fluorocarbon system resin ingredient thru/or any 1 term of 3.
[Claim 5]
Said resin ingredient is an electric wire given in claim 1 characterized by being the mixture of a polyolefine system resin ingredient and a polyamide system resin ingredient, being the mixture of a polyolefine system resin ingredient and a fluorocarbon system resin ingredient, or being the mixture of a polyamide system resin ingredient and a fluorocarbon system resin ingredient thru/or any 1 term of 4.
[Claim 6]
Said resin ingredient is an electric wire given in claim 1 characterized by being the mixture of a polyolefine system resin ingredient, a polyamide system resin ingredient, and a fluorocarbon system resin ingredient thru/or any 1 term of 4.
[Claim 7]
It extrudes from the crosshead of an extruder in the condition of conveying a conductor and the fused insulator and not sticking it at a rate different, respectively. Said insulator is the manufacture approach of the electric wire characterized by being the extended resin ingredient including the electric-wire extrusion process which forms one temporary electric wire which it comes to cool, and the electric-wire drawing process which is made to cool slowly and forms an electric wire after making it extend and narrow-diameter-ize, heating the temporary electric wire.
[Claim 8]
The structure of said resin ingredient is the manufacture approach of the electric wire according to claim 7 characterized by carrying out orientation.
[Claim 9]
Said resin ingredient is the manufacture approach of the electric wire according to claim 7 characterized by crystallizing.
[Claim 10]
Said resin ingredient is the manufacture approach given in claim 7 characterized by being a polyolefine system resin ingredient, being a polyamide system resin ingredient, or being a fluorocarbon system resin

ingredient thru/or any 1 term of 9.
[Claim 11]
Said resin ingredient is the manufacture approach of an electric wire given in claim 7 characterized by being the mixture of a polyolefine system resin ingredient and a polyamide system resin ingredient, being the mixture of a polyolefine system resin ingredient and a fluorocarbon system resin ingredient, or being the mixture of a polyamide system resin ingredient and a fluorocarbon system resin ingredient thru/or any 1 term of 9.
[Claim 12]
Said resin ingredient is the manufacture approach of an electric wire given in claim 7 characterized by being the mixture of a polyolefine system resin ingredient, a polyamide system resin ingredient, and a fluorocarbon system resin ingredient thru/or any 1 term of 9.
[Claim 13]
The manufacture approach of an electric wire given in claim 7 to which the bearer rate of a conductor is characterized by being 4 to 8 times the bearer rate of a melting insulator in said electric-wire extrusion process thru/or any 1 term of 12.
[Claim 14]
The manufacture approach of an electric wire given in claim 7 characterized by the bearer rate of a conductor and the bearer rate of a melting insulator being the same in said electric-wire drawing process thru/or any 1 term of 13.
[Claim 15]
The manufacture approach of an electric wire given in claim 7 characterized by heating said temporary electric wire by steam or hot blast in said electric-wire drawing process thru/or any 1 term of 14.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention]
[0001]
This invention relates to the high electric wire and its manufacture approach of tensile strength.
[Background of the Invention]
[0002]
the request of the miniaturization of the control circuit accompanying the miniaturization of these devices etc. to the complication list of the control circuit accompanying high-performance-izing of an electrical machinery and apparatus in recent years, electronic equipment, and an automobile, lightweight-izing of an automobile, etc. -- an electric wire -- while lightweight-izing a conductor -- thinning -- carrying out -- more -- deflection -- easy -- to be able to wire a narrower tooth space is desired.
[0003]
However, the electric wire which consists of annealed copper had a fault with low tensile strength, although conductivity was excellent.

[0004]
The moiety of the electric wire with which the strand twisted around a core wire by a core wire consisting of beryllium copper in order to conquer the above-mentioned fault and to raise reinforcement consists of annealed copper, and the strand twisted to a core wire consists of beryllium copper, and the electric wire which has arranged by turns the strand which other strands and core wires which are twisted to a core wire consist of annealed copper, and consists of beryllium copper, and the strand which consists of annealed copper around a core wire is indicated. (Patent reference 1)
[0005]
Moreover, since the load burden of the electrical conducting material which is an outer layer line is mitigable to the stretch produced when a conductor receives crookedness because an outer layer line consists of copper or a copper alloy and the elastic modulus of a center line consists of a metal wire which is 2.5 or more times of the elastic modulus of an outer layer line, it is indicated that tensile strength and flexibility have been improved. (Patent reference 2)
[0006]
moreover, the annealed copper stranded wire which carried out the said alignment twist of two or more annealed copper strands 2, and formed them in the outside by making into a core material the tension members 1, such as stainless steel material arranged in the core, -- a conductor 3 is formed and the insulated wire 5 which performed pre-insulation 4 which becomes the outside from a vinyl chloride, polyethylene, etc. further is indicated. (Patent reference 3)
[0007]
Moreover, it is the electric wire which twisted two or more aluminium wires used as a conductor around the steel wire as a tension member, or a steel stranded wire, and while forming in the front face of this aluminium wire the metallic-coating layer which has high endurance, having prepared the insulating layer between the aluminium wires, the steel wire, or the steel stranded wires with which these metallic-coating layer was formed is indicated. (Patent reference 4)
[0008]
The stranded wire which twisted the fiber set line or them which were made into the body is used as a center line, and the metal wire for electric conduction is twisted on the center line. moreover, many carbon fibers -- gathering -- resin -- hardening -- a line -- between the center line and the metal wire for electric conduction The interlayer who consists of an ingredient [elasticity / resin / of a fiber set line] is made to intervene, and since this interlayer acts as a buffer, it is indicated that the resin which has hardened the carbon fiber stops breaking also according to the bolting force of cover printing or grasping metallic ornaments applied at the time of **** passage of extension work. (Patent reference 5)
[0009]
Furthermore, poly para-phenylene benzoscrew oxazole fiber (PBO fiber) is made into reinforcement. It is the lightweight low sag overhead wire which comes to arrange a conductor on the outside of the high tension wire rod by which the front face of the wire rod of the fiber-reinforced-plastics complex which makes a matrix the resin which lays this poly para-phenylene benzoscrew oxazole fiber underground is covered in the metallic conductor layer. By considering as reinforcement, this coefficient of linear expansion the PBO fiber which shows a negative value The overhead wire with which the dip depressor effect under hot environments is good with overhead wire, and made this high tension wire rod the tension member Even if it is lightweight and lifting of the electric-wire temperature by the increment in the load current takes place, it is indicated by that of ** with few increments in a dip that this overhead power line can mitigate the burden to a steel tower. (Patent reference 6)
[0010]
[Patent reference 1] JP,2000-228116,A (2nd page - the 3rd page, drawing 1)
[0011]
[Patent reference 2] JP,07-249315,A (2nd page - the 3rd page, drawing 1)
[0012]
[Patent reference 3] JP,2003-123542,A (the 1st page, drawing 1)
[0013]
[Patent reference 4] JP,2002-117723,A (3rd page - the 5th page, drawing 1 - drawing 2 , drawing 4)
[0014]
[Patent reference 5] JP,5-83931,U (2nd page - the 5th page, drawing 1)

[0015]
[Patent reference 6] JP,10-321047,A (2nd page - the 6th page, drawing 1 - drawing 2)
[Description of the Invention]
[Problem(s) to be Solved by the Invention]
[0016]
However, since stainless steel etc. was used for the electric wire currently indicated by above-mentioned JP,2000-228116,A, JP,07-249315,A, JP,2003-123542,A, and JP,2002-117723,A as reinforcing materials of an insulator in order to raise reinforcement, the production process became complicated and it had the problem that cost was also high. Moreover, the problem which recovery of an annealed copper electric wire is difficult, and cannot recycle alloys, such as stainless steel, since it was mixed into the electric wire was during the above-mentioned electric-wire manufacture.
[0017]
Moreover, although the electric wire currently indicated by JP,5-83931,U is the middle class who is making it intervene between the center lines and the metal wires for electric conduction which are called a carbon fiber set line and destruction by cover printing and the bolting force of a carbon fiber set line was lost, there was a problem that the tensile strength of the whole electric wire was low.
[0018]
Furthermore, the electric wire currently indicated by JP,10-321047,A had the problem that the tensile strength of the whole electric wire was low too, although the dip depressor effect under hot environments was good and was able to attain lightweight-ization of an electric wire because coefficient of linear expansion makes reinforcement the PBO fiber which shows a negative value.
[0019]
That is, its tensile strength of an insulator was weak, and since the reinforcement hearts, such as stainless steel and a copper alloy, were used for the structure of the conventional high intensity electric wire in order to reinforce it, cost was high [structure]. Moreover, there were problems, such as electric corrosion by the difference of the ionization tendency by using dissimilar metals, such as copper and steel, together. Moreover, conventionally, the amount of preferred orientation of an insulator was low, and since the elongation percentage was higher than a conductor, the contribution of an insulator was low at the time of electric-wire fracture, in order to be only cooling the electric wire which came out of the crosshead of an extruder with water cooling and not to make it extend.
[0020]
This invention is made in view of the above-mentioned problem, and carries out enforcement orientation by extending the insulator which is a resin ingredient, it is making it crystallize by annealing further, and it aims at offering the high intensity electric wire whose recycle is possible, and its manufacture approach, without using reinforcing materials.
[Means for Solving the Problem]
[0021]
The electric wire which carried out drawing annealing of the insulator resin ingredient of the invention in this application that the above-mentioned technical problem should be solved The manufacture approach of the electric wire which consisted of a conductor and an insulator which covers it, decided that tensile strength is 100 or more Mpas, and carried out drawing annealing of the insulator resin ingredient of the invention in this application It extrudes from the crosshead of an extruder in the condition of conveying a conductor and the fused insulator and not sticking it at a rate different, respectively. We decided to include the electric-wire extrusion process which forms one temporary electric wire which it comes to cool, and the electric-wire drawing process which is made to cool slowly and forms an electric wire after making it extend and narrow-diameter-ize, heating the temporary electric wire.
[0022]
Moreover, the above-mentioned insulator is the extended resin ingredient, and this resin ingredient has the structure which is carrying out orientation, and is crystallizing.
[0023]
Moreover, the above-mentioned resin ingredient is a polyolefine system resin ingredient, is a polyamide system resin ingredient, or is a fluorocarbon system resin ingredient.
[0024]

Moreover, the above-mentioned resin ingredient is the mixture of a polyolefine system resin ingredient and a polyamide system resin ingredient, is the mixture of a polyolefine system resin ingredient and a fluorocarbon system resin ingredient, or is the mixture of a polyamide system resin ingredient and a fluorocarbon system resin ingredient.
[0025]
Furthermore, the above-mentioned resin ingredient is the mixture of a polyolefine system resin ingredient, a polyamide system resin ingredient, and a fluorocarbon system resin ingredient.
[0026]
Moreover, in the above-mentioned electric-wire extrusion process, the bearer rate of a conductor is 4 to 8 times the bearer rate of a melting insulator.
[0027]
Furthermore, in the above-mentioned electric-wire drawing process, the bearer rate of a melting insulator is the same as the bearer rate of a conductor, and decided to heat the above-mentioned temporary electric wire by steam or hot blast.
[Effect of the Invention]
[0028]
According to the electric wire in this invention explained above, even if it does not use reinforcing materials, such as stainless steel, a high intensity electric wire can be obtained.
[0029]
Moreover, according to the manufacture approach of the electric wire in this invention, by not using reinforcing materials, such as stainless steel, a production process becomes easy and a cost cut can be aimed at.
[Best Mode of Carrying Out the Invention]
[0030]
The gestalt of operation of this invention is explained based on an accompanying drawing below. Drawing 1 is the sectional view showing the gestalt of 1 operation of the electric wire concerning this invention here, drawing 2 is drawing showing roughly the gestalt of 1 implementation of the manufacture approach of the electric wire concerning this invention, and drawing 3 is important section drawing of longitudinal section showing an example of the head section of the extruder in drawing 2 .
[0031]
As shown in drawing 1 , the electric wire 1 has composition with which the insulator layer 3 was covered by the periphery of a conductor 2. Using annealed copper as a gestalt of operation shown in drawing 1 , a conductor 2 is arranged in in the shape of the center of a circle by seven, and becomes one bundle. In addition, the bundle of two or more annealed copper as which one annealed copper is sufficient is sufficient as a conductor 2. The insulator layer 3 may consist of an insulator and the resin ingredient which has crystallinity further may be used. This resin ingredient is making it extend, heating, orientation of the internal molecule is carried out and it is crystallizing it with subsequent water cooling further.
[0032]
Moreover, the above-mentioned resin ingredient is for example, a polyolefine system resin ingredient, is a polyamide system resin ingredient, or is a fluorocarbon system resin ingredient.
[0033]
Moreover, the above-mentioned resin ingredient is the mixture of a polyolefine system resin ingredient and a polyamide system resin ingredient, is the mixture of a polyolefine system resin ingredient and a fluorocarbon system resin ingredient, or is the mixture of a polyamide system resin ingredient and a fluorocarbon system resin ingredient.
[0034]
Furthermore, the above-mentioned resin ingredient is the mixture of a polyolefine system resin ingredient, a polyamide system resin ingredient, and a fluorocarbon system resin ingredient.
[0035]
By extending and annealing a resin ingredient with crystallinity, by making the hauling modulus of elasticity (or tensile strength) and elongation after fracture of a conductor 2 and the insulator layer 3 into this level, the electric wires 1 which have such structure are a conductor 2 and the sum total of both of the insulator layer 3, and can increase reinforcement (tensile strength) at the time of the breaking load of

an electric wire by both making high the amount of preferred orientation of the molecule of a resin ingredient, and degree of crystallinity.
[0036]
Next, the manufacture approach of an electric wire is explained. As shown in drawing 2 , after the conductor 2 supplied from a supply anneals by ANIRA, and preheating is carried out by the pre-heater after that and it warms up, it is sent to an extruder.
[0037]
The extruder shown in drawing 2 installs the resin ingredient input port which throws in the crystalline resin ingredient 10 (namely, insulator ingredient) which tends to intersect perpendicularly in the conveyance direction of a conductor 2, and is installing the crosshead which twists a conductor 2 and the resin ingredient 10 together, and sends them further. The important section structure of this crosshead is shown in drawing 3 .
[0038]
As shown in drawing 3 , a conductor 2 is sent out to a crosshead in the conveyance direction shown in drawing at a rate A through the conveyance section 5 currently maintained in the conveyance space of a conductor 2 by rodding 4. The screw 7 is formed in the interior of the extrusion cylinder 6 which intersects perpendicularly with the conveyance section 5 free [a revolution]. The resin ingredient 10 which is heated at the heater which is not shown in drawing and will be in a melting condition flows into the resin ingredient style admission into a club 8, and is covered as an insulator layer 3 around a conductor 2. The inlet velocity B of the resin ingredient 10 is controlled by the screw 7.
[0039]
if the bearer rate of a conductor 2 is set to A (a part for m/) and inlet velocity of the resin ingredient 10 is set to B (a part for m/) -- about
A=(4-8) *B (1)
A conductor 2 is conveyed by the relation in which ****** is materialized.
[0040]
Making aperture of the crosshead of an extruder thick and maintaining the relation of the above-mentioned (1) formula, in the condition that the insulator layer 3 of the resin ingredient 10 does not stick to a conductor 2, it extrudes, the temporary electric wire 9 is formed, it is sent to the 1st cooling water tank which shows this temporary electric wire 9 to drawing 2 and drawing 3 , and water cooling is carried out at the temperature of 10-15 degrees C. At this time, the insulator layer 3 of the resin ingredient 10 of a melting condition solidifies, and serves as a solid-state.
[0041]
Next, the temporary electric wire 9 is sent to the 1st taking over machine, and the send rate of the resin ingredient 10 is adjusted. In this example, as the 1st taking over machine, although belt-type send equipment is used, if the send rate of the resin ingredient 10 can be adjusted, it is not especially scrupulous.
[0042]
And as shown in drawing 2 , similarly those bearer rates change a conductor 2 and the insulator layer 3, and they are sent to the following heating apparatus. With this heating apparatus, while a conductor 2 and the insulator layer 3 are heated at 100-180 degrees C by steam or hot blast, the rate for 40-80m/, orientation of that molecule is carried out, it unites with a conductor 2, and the insulator layer 3 is extended and an electric wire 1 is formed [it is narrow-diameter-ized and]. Then, an electric wire 1 is sent to the 2nd cooling water tank, and the extended insulator layer 3 is annealed by water cooling, and progresses crystallization. Finally, it rolls round with a **** machine through the 2nd taking over machine.
[0043]
Thus, although it is raising the amount of preferred orientation and progressing crystallization by a drawing and annealing and elongation after fracture falls to about 30%, tensile strength of the insulator layer 3 improves. Since the elongation after fracture of a conductor 2 is about 20 - 30%, the elongation after fracture as the electric-wire 1 whole becomes about 30%.
[Availability on industry]
[0044]
While raising the tensile strength of an electric wire with orientation and making it crystallize for the

structure of an insulator by extending the insulator in an electric wire and cooling, the production process also becomes easy and a cost cut can be aimed at.
[Brief Description of the Drawings]
[0045]
[Drawing 1] The sectional view showing the gestalt of 1 operation of the electric wire concerning this invention.
[Drawing 2] Drawing showing roughly the gestalt of 1 implementation of the manufacture approach of the electric wire concerning this invention.
[Drawing 3] Important section drawing of longitudinal section showing an example of the head section of the extruder in drawing 2 .
[Description of Notations]
[0046]
1 -- Electric wire 2 -- Conductor 3 -- Insulator layer 4 -- Rodding 5 -- Conveyance section 6 -- Extrusion cylinder 7 -- Screw 8 -- Resin ingredient style admission into a club 9 -- Temporary electric wire 10 -- Resin ingredient.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[0045]
[Drawing 1] The sectional view showing the gestalt of 1 operation of the electric wire concerning this invention.
[Drawing 2] Drawing showing roughly the gestalt of 1 implementation of the manufacture approach of the electric wire concerning this invention.
[Drawing 3] Important section drawing of longitudinal section showing an example of the head section of the extruder in drawing 2 .

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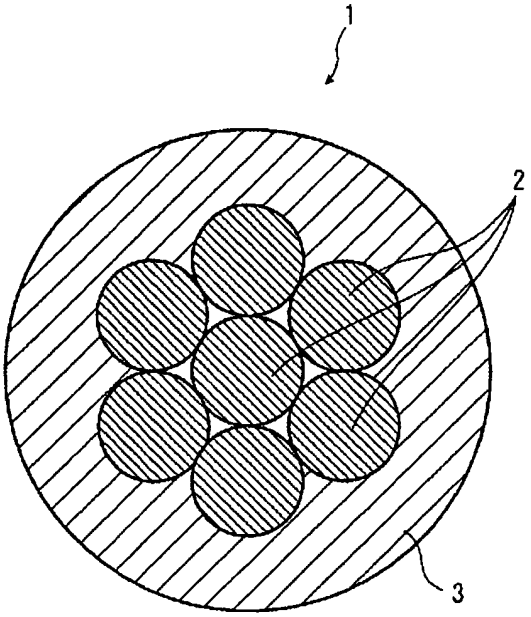
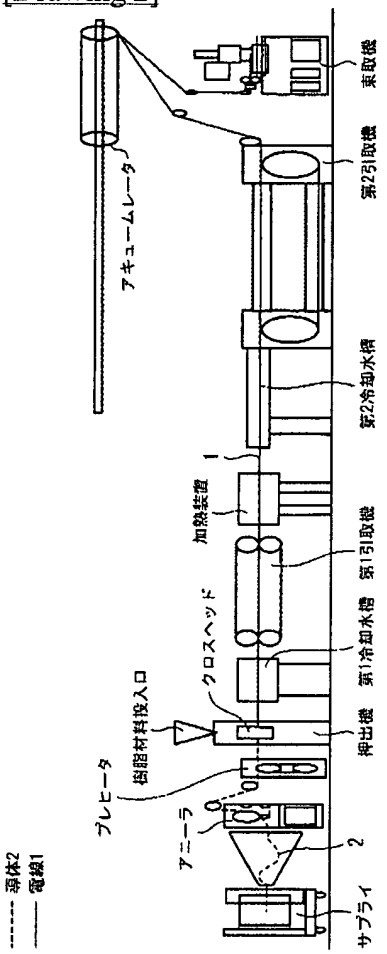
DRAWINGS

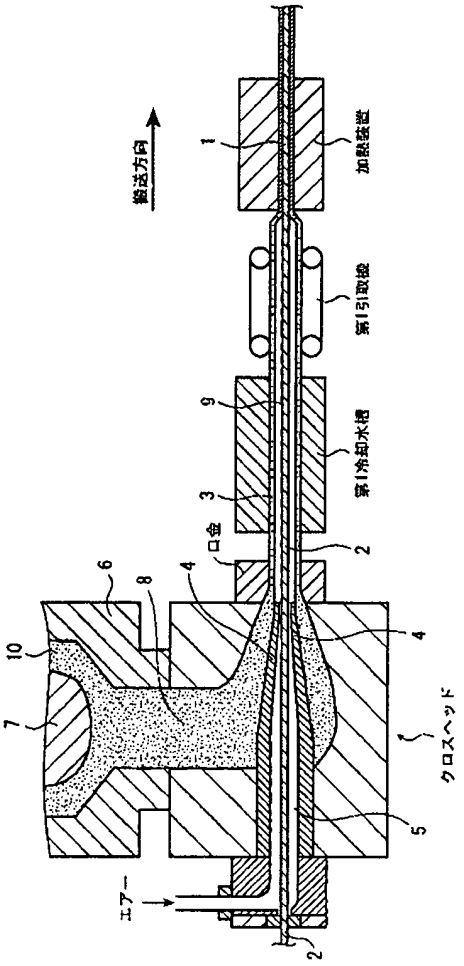
[Drawing 1]



[Drawing 2]



[Drawing 3]



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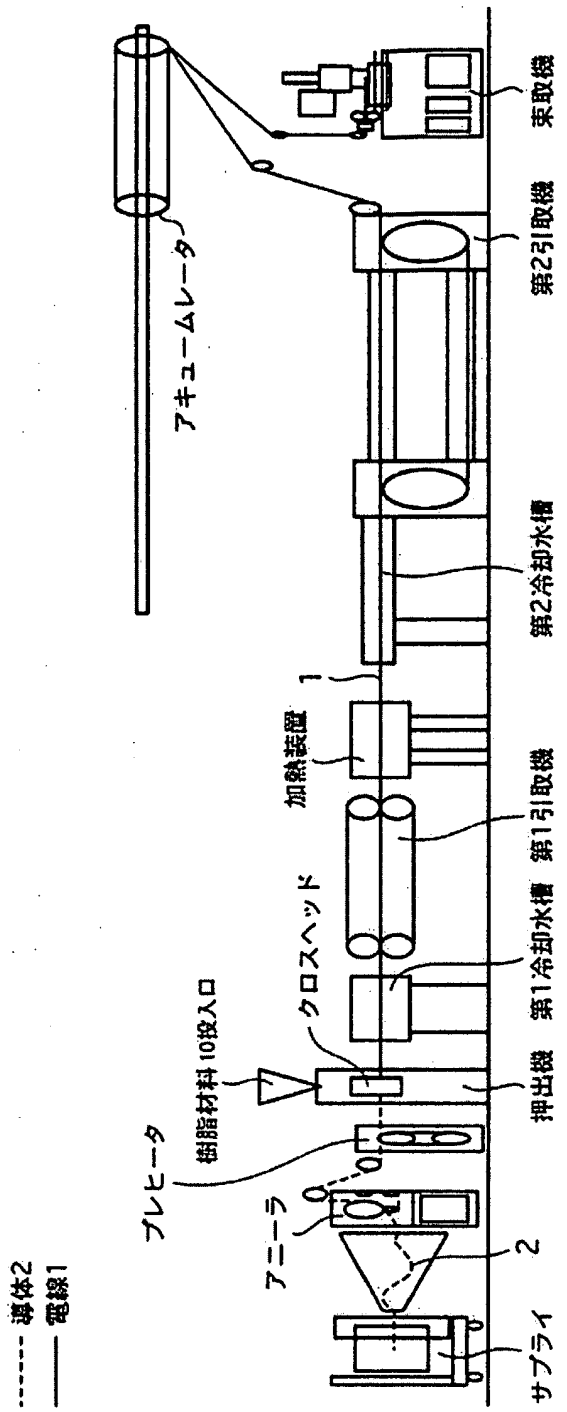
WRITTEN AMENDMENT

[Procedure amendment]
[Filing Date] June 1, Heisei 16 (2004. 6.1)
[Procedure amendment 1]
[Document to be Amended] DRAWINGS
[Item(s) to be Amended] drawing 2
[Method of Amendment] Modification
[The content of amendment]
[Drawing 2]



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(43)公開日　平成17年12月8日(2005.12.8)

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H01B 13/14	H01B 13/14	Z	5G325

審査請求 未請求　請求項の数 15　OL　（全 10 頁）

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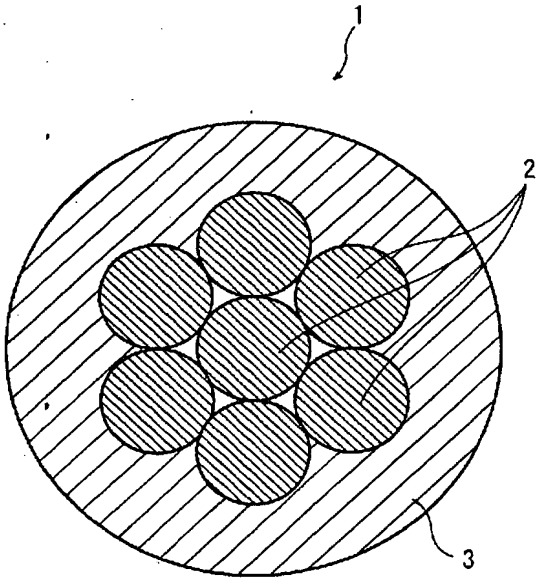
最終頁に続く

(54)【発明の名称】電線及びその製造方法

(57)【要約】
【課題】　補強材を用いることなく、かつリサイクルのできる高強度な電線及びその製造方法を提供する。
【解決手段】　電線と溶融した絶縁体とをそれぞれ異なる速度で搬送し、密着しない状態で押出機のクロスヘッドから押出して、冷却されてなる一本の仮電線を形成する電線押出工程と、その仮電線を加熱しながら、延伸して細径化させてから、徐冷させて、電線を形成する電線延伸工程とを含む電線の製造方法。電線とそれを被覆する絶縁体からなり、かつ引っ張り強度が１００Mpa以上であることを特徴とする電線。
【選択図】　図１



【特許請求の範囲】
【請求項1】
導体とそれを被覆する絶縁体からなる電線において、前記絶縁体は、延伸された樹脂材料であり、前記電線の引っ張り強度が１００Mpa以上であることを特徴とする電線。
【請求項2】
前記樹脂材料の構造は、配向していることを特徴とする請求項１に記載の電線。
【請求項3】
前記樹脂材料は、結晶化していることを特徴とする請求項１に記載の電線。
【請求項4】
前記樹脂材料は、ポリオレフィン系樹脂材料であり、若しくはポリアミド系樹脂材料であり、若しくはフロロカーボン系樹脂材料であることを特徴とする請求項１乃至３のいずれか１項に記載の電線。
【請求項5】
前記樹脂材料は、ポリオレフィン系樹脂材料とポリアミド系樹脂材料との混合物であり、若しくはポリオレフィン系樹脂材料とフロロカーボン系樹脂材料との混合物であり、若しくはポリアミド系樹脂材料とフロロカーボン系樹脂材料との混合物であることを特徴とする請求項１乃至４のいずれか１項に記載の電線。
【請求項6】
前記樹脂材料は、ポリオレフィン系樹脂材料とポリアミド系樹脂材料とフロロカーボン系樹脂材料との混合物であることを特徴とする請求項１乃至４のいずれか１項に記載の電線。
【請求項7】
導体と溶融した絶縁体とをそれぞれ異なる速度で搬送し、密着しない状態で押出機のクロスヘッドから押出して、冷却されてなる一本の仮電線を形成する電線押出工程と、その仮電線を加熱しながら、延伸して細径化させてから、徐冷させて、電線を形成する電線延伸工程とを含み、前記絶縁体は、延伸された樹脂材料であることを特徴とする電線の製造方法。
【請求項8】
前記樹脂材料の構造は、配向させていることを特徴とする請求項７に記載の電線の製造方法。
【請求項9】
前記樹脂材料は、結晶化していることを特徴とする請求項７に記載の電線の製造方法。
【請求項10】
前記樹脂材料は、ポリオレフィン系樹脂材料であり、若しくはポリアミド系樹脂材料であり、若しくはフロロカーボン系樹脂材料であることを特徴とする請求項７乃至９のいずれか１項に記載の製造方法。
【請求項11】
前記樹脂材料は、ポリオレフィン系樹脂材料とポリアミド系樹脂材料との混合物であり、若しくはポリオレフィン系樹脂材料とフロロカーボン系樹脂材料との混合物であり、若しくはポリアミド系樹脂材料とフロロカーボン系樹脂材料との混合物であることを特徴とする請求項７乃至９のいずれか１項に記載の電線の製造方法。
【請求項12】
前記樹脂材料は、ポリオレフィン系樹脂材料とポリアミド系樹脂材料とフロロカーボン系樹脂材料との混合物であることを特徴とする請求項７乃至９のいずれか１項に記載の電線の製造方法。
【請求項13】
前記電線押出工程において、導体の搬送速度が、溶融絶縁体の搬送速度の４～８倍であることを特徴とする請求項７乃至１２のいずれか１項に記載の電線の製造方法。
【請求項14】

前記電線延伸工程において、導体の搬送速度と溶融絶縁体の搬送速度が同じであることを特徴とする請求項７乃至１３のいずれか１項に記載の電線の製造方法。
【請求項15】
前記電線延伸工程において、スチーム又は熱風により前記仮電線を加熱することを特徴とする請求項７乃至１４のいずれか１項に記載の電線の製造方法。
【発明の詳細な説明】
【技術分野】
【0001】
本発明は、引っ張り強度の高い電線及びその製造方法に関する。
【背景技術】
【0002】
近年の電気機器、電子機器及び自動車の高性能化に伴う制御回路の複雑化並びにこれらの機器等の小型化に伴う制御回路の小型化、自動車の軽量化等の要請により、電線導体を軽量化すると共に、細線化してより曲がりやすく、より狭いスペースに配線できることが望まれている。
【0003】
しかし、軟銅からなる電線は、導電性が優れているものの、引っ張り強度が低い欠点があった。
【0004】
上記の欠点を克服して、強度を上げるために、芯線がベリリウム銅からなり、芯線の周囲に撚り合わせる素線が軟銅からなる電線と、芯線に撚り合わせる素線の半数がベリリウム銅からなり、芯線に撚り合わせる他の素線及び芯線が軟銅からなり、ベリリウム銅からなる素線と、軟銅からなる素線を、芯線の周囲に交互に配置した電線とが開示されている。（特許文献１）
【0005】
また、外層線が銅或いは銅合金よりなり、中心線の弾性係数が外層線の弾性係数の２．５倍以上である金属線よりなることで、導体が屈曲を受ける場合に生じる延びに対して、外層線である導電材料の荷重負担が軽減できるので、引っ張り強度及び屈曲性が改善されたことが開示されている。（特許文献２）
【0006】
また、中心部に配置されたステンレス鋼材等のテンションメンバー１を芯材として、その外側に複数本の軟銅素線２を同心撚りして形成した軟銅撚線導体３を設け、さらにその外側に塩化ビニルやポリエチレン等からなる絶縁被覆４を施した絶縁電線５が開示されている。（特許文献３）
【0007】
また、テンションメンバーとしての鋼線又は鋼撚り線の周囲に、導体となるアルミニウム線を複数本撚り合わせた電線であり、このアルミニウム線の表面に高耐久性を有する金属被覆層を形成すると共に、これら金属被覆層が形成されたアルミニウム線と鋼線又は鋼撚り線との間に絶縁層を設けたことが開示されている。（特許文献４）
【0008】
また、多数のカーボンファイバを集合して樹脂で固めて線状体としたファイバ集合線又はそれらを撚り合わせた撚線を中心線とし、その中心線上に導電用金属線を撚り合わせ、その中心線と導電用金属線との間に、ファイバ集合線の樹脂より軟質な材料からなる中間層を介在させ、この中間層は、緩衝体として作用するので、延線工事の金車通過時にかかるしごきや把持金具類の締付け力によっても、カーボンファイバを固めている樹脂が破壊しなくなることが記載されている。（特許文献５）
【0009】
さらに、ポリパラフェニレンベンゾビスオキサゾール繊維（ＰＢＯ繊維）を強化材とし、このポリパラフェニレンベンゾビスオキサゾール繊維を埋設する樹脂をマトリックスとする繊維強化プラスチック複合体の線材の表面が金属導体層で被覆されている高張力線材

の外側に導体を配置してなる軽量低弛度架空電線であって、この線膨張係数が負の値を示すＰＢＯ繊維を強化材としていることで、高温環境下における弛度抑制効果が良好であり、また、この高張力線材をテンションメンバとした架空電線は、軽量であり、かつ負荷電流の増加による電線温度の上昇が起こっても弛度増加が少ないので、この架空送電線が鉄塔への負担を軽減することができることが記載されている。（特許文献６）

【0010】

【特許文献1】特開２０００－２２８１１６号公報（第２頁～第３頁、図１）

【0011】

【特許文献2】特開平０７－２４９３１５号公報（第２頁～第３頁、図１）

【0012】

【特許文献3】特開２００３－１２３５４２号公報（第１頁、図１）

【0013】

【特許文献4】特開２００２－１１７７２３号公報（第３頁～第５頁、図１～図２、図４）

【0014】

【特許文献5】実開平５－８３９３１号公報（第２頁～第５頁、図１）

【0015】

【特許文献6】特開平１０－３２１０４７号公報（第２頁～第６頁、図１～図２）

【発明の開示】

【発明が解決しようとする課題】

【0016】

しかしながら、上記特開２０００－２２８１１６号公報、特開平０７－２４９３１５号公報、特開２００３－１２３５４２号公報、及び特開２００２－１１７７２３号公報に開示されている電線は、強度を上げるために、絶縁体の補強材としてステンレス等を用いたために、製造工程が複雑になり、コストも高かったという問題があった。また、上記の電線製造中に、ステンレス等の合金を電線の中に混じり込んだために、軟銅電線の回収が困難であり、リサイクルできない問題があった。

【0017】

また、実開平５－８３９３１号公報に開示されている電線は、カーボンファイバ集合線という中心線と導電用金属線との間に介在させている中間層で、カーボンファイバ集合線のしごきや締付け力による破壊を無くしたが、電線全体の引っ張り強度が低い問題があった。

【0018】

更に特開平１０－３２１０４７号公報に開示されている電線は、線膨張係数が負の値を示すＰＢＯ繊維を強化材としていることで、高温環境下における弛度抑制効果が良好で、電線の軽量化を図ることができたが、やはり電線全体の引っ張り強度が低い問題があった。

【0019】

即ち、従来の高強度電線の構造は、絶縁体の引っ張り強度が弱く、それを補強するために、ステンレス、銅合金等の補強芯を用いたため、コストが高かった。また、銅、鋼材等の異種金属を併用することによるイオン化傾向の差による電食等の問題があった。また、従来は、押出機のクロスヘッドから出てきた電線を水冷により冷却するのみで、延伸させないため、絶縁体の配向度が低く、伸び率が導体より高いため、電線破断時には、絶縁体の寄与率が低かった。

【0020】

本発明は、上記の問題に鑑みてなされたものであり、樹脂材料である絶縁体を延伸することにより強制配向させ、さらに徐冷により結晶化をさせることで、補強材を用いることなく、かつリサイクルのできる高強度な電線及びその製造方法を提供することを目的とする。

【課題を解決するための手段】

【0021】
上記課題を解決すべく本願発明の絶縁体樹脂材料を延伸徐冷した電線は、導体とそれを被覆する絶縁体からなり、かつ引っ張り強度が１００Mpa以上であることとし、また、本願発明の絶縁体樹脂材料を延伸徐冷した電線の製造方法は、導体と溶融した絶縁体とをそれぞれ異なる速度で搬送し、密着しない状態で押出機のクロスヘッドから押出して、冷却されてなる一本の仮電線を形成する電線押出工程と、その仮電線を加熱しながら、延伸して細径化させてから、徐冷させて、電線を形成する電線延伸工程とを含むこととした。
【0022】
また、上記絶縁体は、延伸された樹脂材料であり、この樹脂材料は、配向している構造を有し、結晶化している。
【0023】
また、上記の樹脂材料は、ポリオレフィン系樹脂材料であり、若しくはポリアミド系樹脂材料であり、若しくはフロロカーボン系樹脂材料である。
【0024】
また、上記樹脂材料は、ポリオレフィン系樹脂材料とポリアミド系樹脂材料との混合物であり、若しくはポリオレフィン系樹脂材料とフロロカーボン系樹脂材料との混合物であり、若しくはポリアミド系樹脂材料とフロロカーボン系樹脂材料との混合物である。
【0025】
更に、上記樹脂材料は、ポリオレフィン系樹脂材料とポリアミド系樹脂材料とフロロカーボン系樹脂材料との混合物である。
【0026】
また、上記電線押出工程において、導体の搬送速度が、溶融絶縁体の搬送速度の４～８倍である。
【0027】
さらに、上記電線延伸工程において、導体の搬送速度と溶融絶縁体の搬送速度が同じであり、スチーム又は熱風により上記仮電線を加熱することとした。
【発明の効果】
【0028】
以上に説明した本発明における電線によれば、ステンレス等の補強材を用いなくても、高強度な電線を得ることができる。
【0029】
また、本発明における電線の製造方法によれば、ステンレス等の補強材を用いていないことで、製造工程が簡単になり、コストダウンを図ることができる。
【発明を実施するための最良の形態】
【0030】
以下に本発明の実施の形態を添付図面に基づいて説明する。ここで、図１は、本発明に係る電線の一実施の形態を示す断面図であり、図２は、本発明に係る電線の製造方法の一実施の形態を概略的に示す図であり、図３は、図２における押出機のヘッド部の一例を示す要部縦断面図である。
【0031】
図１に示すように、電線１は、導体２の外周に絶縁体層３が被覆された構成になっている。図１に示す実施の形態として、導体２は、軟銅を用い、７本で円心状に並べて、一束となる。なお、導体２は、一本の軟銅でもよい、複数本の軟銅の束でもよい。絶縁体層３は、絶縁体からなり、更に結晶性を有する樹脂材料を用いてもよい。この樹脂材料は、加熱しながら延伸させることで、内部の分子が配向され、更にその後の水冷により結晶化している。
【0032】
また、上記の樹脂材料は、例えば、ポリオレフィン系樹脂材料であり、若しくはポリアミド系樹脂材料であり、若しくはフロロカーボン系樹脂材料である。
【0033】

また、上記樹脂材料は、ポリオレフィン系樹脂材料とポリアミド系樹脂材料との混合物であり、若しくはポリオレフィン系樹脂材料とフロロカーボン系樹脂材料との混合物であり、若しくはポリアミド系樹脂材料とフロロカーボン系樹脂材料との混合物である。

【0034】

更に、上記樹脂材料は、ポリオレフィン系樹脂材料とポリアミド系樹脂材料とフロロカーボン系樹脂材料との混合物である。

【0035】

このような構造を有する電線１は、結晶性のある樹脂材料を延伸、徐冷することにより、樹脂材料の分子の配向度と、結晶化度とをともに高くすることで、導体２と絶縁体層３の引っ張り弾性率（若しくは引っ張り強度）及び破断伸びを同レベルにすることにより、電線の破断荷重時に、導体２と絶縁体層３の両者の合計で、強度（引っ張り強度）を増すことができる。

【0036】

次に電線の製造方法を説明する。図２に示すように、サプライから供給される導体２が、アニーラによって焼き鈍しをして、その後、プレヒータにより予備加熱され、暖まってから、押出機に送られる。

【0037】

図２に示す押出機は、導体２の搬送方向に直交する方向に結晶性のある樹脂材料１０（即ち、絶縁体材料）を投入する樹脂材料投入口を設置し、更に導体２と樹脂材料１０とを一緒に撚り送るクロスヘッドを設置している。このクロスヘッドの要部構造を図３に示す。

【0038】

図３に示すように、クロスヘッドには、芯金４で導体２の搬送空間を保たれている搬送部５を通じて、導体２は、速度Ａで図に示す搬送方向で送り出す。搬送部５と直交する押出シリンダ６の内部にスクリュー７が回転自在に設けられている。図に示さないヒーターで加熱され溶融状態となる樹脂材料１０が樹脂材料流入部８に流入され、導体２の周囲に絶縁体層３として被覆される。樹脂材料１０の流入速度Ｂは、スクリュー７にコントロールされる。

【0039】

導体２の搬送速度をＡ（ｍ／分）とし、樹脂材料１０の流入速度をＢ（ｍ／分）とすると、およそ、

Ａ＝（４～８）＊Ｂ　　（１）

の関係が成立する関係で導体２を搬送する。

【0040】

押出機のクロスヘッドの口径を太くし、上記（１）式の関係を保ちながら、導体２に樹脂材料１０の絶縁体層３が密着しない状態で、押し出して、仮電線９を形成し、この仮電線９を図２及び図３に示す第１冷却水槽に送られ、１０～１５℃の温度で水冷する。この時、溶融状態の樹脂材料１０の絶縁体層３は、固まって固体となる。

【0041】

次に、仮電線９を第１引取機に送られ、樹脂材料１０の送り出し速度を調整する。この実施例では、第１引取機として、ベルト式の送り出し装置を用いるが、樹脂材料１０の送り出し速度を調整できるものなら、特に拘らない。

【0042】

そして、図２に示すように、導体２と絶縁体層３は、それらの搬送速度が同じに変更して、次の加熱装置に送られる。この加熱装置で導体２及び絶縁体層３が、スチーム又は熱風により、１００～１８０℃で加熱されながら、４０～８０ｍ／分の速度で絶縁体層３は延伸され、その分子が配向され、導体２と一体化されて細径化され、電線１が形成される。この後、電線１が、第２冷却水槽に送られ、延伸された絶縁体層３が、水冷により徐冷され、結晶化を進む。最後に、第２引取機を経て、束取機で巻き取る。

【0043】

このように、絶縁体層３は、延伸、徐冷により、配向度を高め、結晶化を進むことで、破断伸びが約３０％まで低下するが、引っ張り強度が向上する。導体２の破断伸びが約２０～３０％であるので、電線１全体としての破断伸びは約３０％となる。

【産業上の利用可能性】

【0044】

電線における絶縁体を延伸、冷却することにより、絶縁体の構造を配向、結晶化させることで、電線の引っ張り強度をあげると同時に、その製造工程も簡単になり、コストダウンを図ることができる。

【図面の簡単な説明】

【0045】

【図1】本発明に係る電線の一実施の形態を示す断面図。

【図2】本発明に係る電線の製造方法の一実施の形態を概略的に示す図。

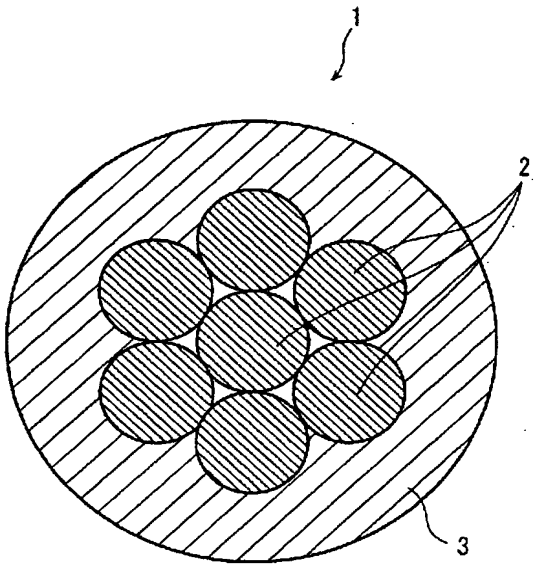
【図3】図２における押出機のヘッド部の一例を示す要部縦断面図。

【符号の説明】

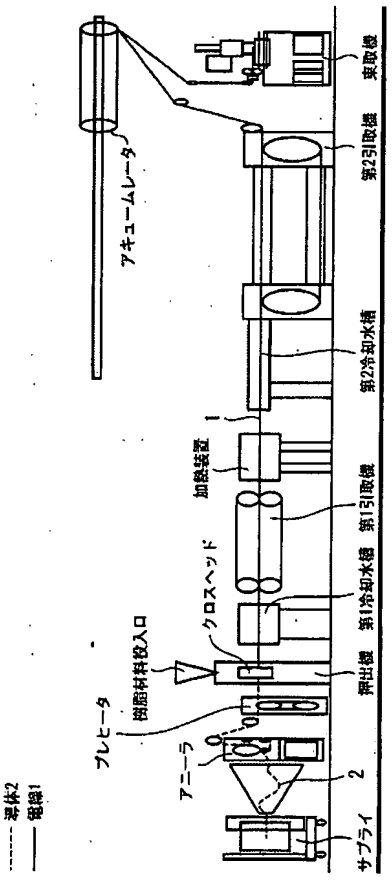
【0046】

１…電線、　２…導体、　３…絶縁体層、　４…芯金、　５…搬送部、　６…押出シリンダ、　７…スクリュー、　８…樹脂材料流入部、　９…仮電線、　１０…樹脂材料。

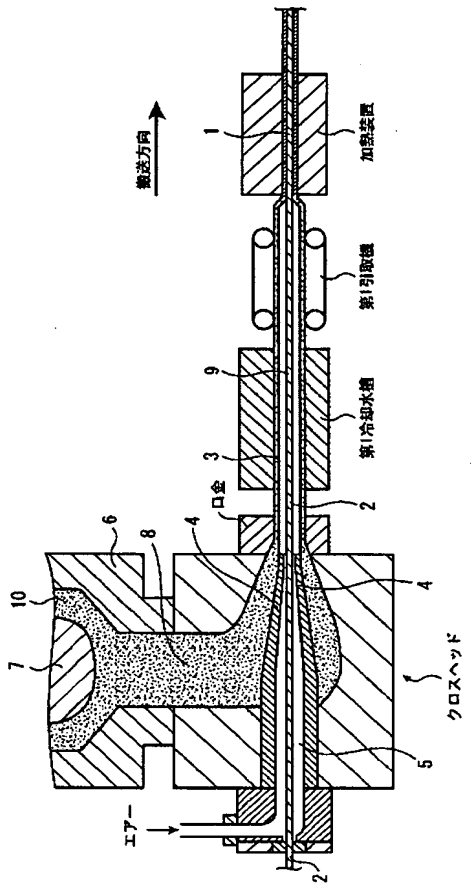
【図1】



【図2】

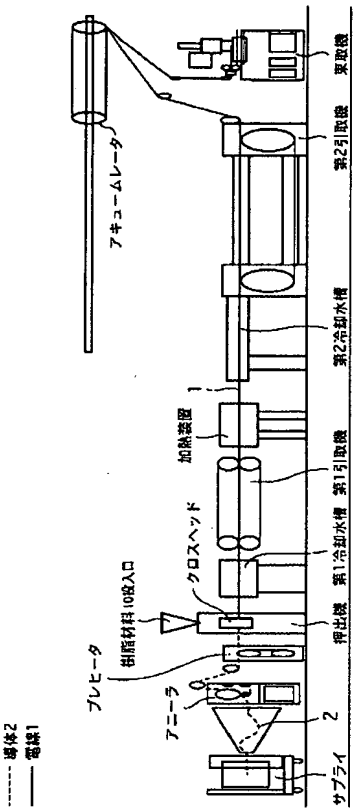


【図3】



【手続補正書】
【提出日】平成16年6月1日(2004.6.1)
【手続補正1】
【補正対象書類名】図面
【補正対象項目名】図２
【補正方法】変更
【補正の内容】

【図2】


導体2
電線1
アキュームレータ
プレヒータ
樹脂材料投入口
クロスヘッド
加熱装置
アニーラ
押出機
第1冷却水槽
第1引取機
第2冷却水槽
第2引取機
巻取機
サプライ
1
2